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A Summary of Herring Tagging in 4VWX, 1998 to 2003.

Résumé des études d'étiquetage du hareng de 4VWX : 1998 – 2003.

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ABSTRACT

From 1998 to 2002, the Pelagics Research Council/Herring Science Council, in partnership with Fisheries and Oceans, Canada, conducted a number of tagging trips on herring spawning grounds and on the major Nova Scotia overwintering grounds. In addition, preliminary experiments were conducted tagging weir herring in the Bay of Fundy and on a single trip to the USA. A total of 92,647 tags were released in that 5 year period. Although this project has concluded tags continue to be returned. The information on returns is presented in this paper.

In 2002 the Fundy Weir Fishermen Association, Inc., in partnership with the New Brunswick Department of Agriculture, Fisheries and Aquaculture, the Grand Manan Fishermen's Association, Connors Brothers Ltd. and Fisheries and Oceans, Canada, initiated a second tagging program, to be conducted over a three year period. The purpose of this project is to investigate the seasonal movements and migration of herring in the Bay of Fundy with the long term goal of providing information on stock structure. From August 21, 2002 to Nov 4, 2002, a total of 13,760 weir herring were tagged and 93 tags have been returned so far. The majority of recoveries have been from herring recaptured close to the site of application, although some were from as far away as Scots Bay off Coastal Nova Scotia and Ipswich Bay off Coastal USA. The results to date are summarized.

RÉSUMÉ

De 1998 à 2002, le Conseil des recherches sur les pêches pélagiques et le Herring Science Council, en partenariat avec Pêches et Océans Canada, ont effectué une série de sorties d'étiquetage dans les frayères du hareng et ses principales zones d'hivernage dans les eaux de la Nouvelle-Écosse. Des expériences préliminaires d'étiquetage du hareng capturé dans des bordigues installées dans la baie de Fundy, ainsi que lors d'une seule sortie dans les eaux américaines, ont aussi été menées. Au total, 92 647 étiquettes ont été posées pendant cette période de cinq ans. Quoique que ce projet ait pris fin, des étiquettes continuent d'être retournées. Le présent document est un résumé des renseignements tirés de celles-ci.

En 2002, la Fundy Weir Fishermen's Association Inc., en partenariat avec le ministère de l'Agriculture, des Pêches et de l'Aquaculture du Nouveau-Brunswick, la Grand Manan Fishermen's Association, Connors Brothers Ltd. et Pêches et Océans Canada, a lancé un deuxième programme d'étiquetage du hareng, qui s'échelonnera sur trois ans. L'objectif de ce projet est d'établir les déplacements saisonniers et la migration du hareng dans la baie de Fundy, le but à long terme étant de recueillir de l'information sur la structure des stocks. Du 21 août au 4 novembre 2002, 13 760 harengs capturés dans des bordigues ont été étiquetés; jusqu'à maintenant, 93 étiquettes ont été retournées. La plupart de celles-ci ont été récupérées près du point où elles ont été posées, mais quelques-unes ont été récupérées beaucoup plus loin, comme dans la baie Scots, en Nouvelle-Écosse, et la baie Ipswich, aux États-Unis. Les résultats obtenus jusqu'à maintenant sont résumés dans le présent document.

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1. INTRODUCTION

The introduction of external anchor tags in the early 1970s set the stage for a more effective and efficient means of tagging large numbers of fish over short time periods. From 1976 to 1981, the International Herring Tagging Program applied over 500,000 tags to herring in Northwest Atlantic Fisheries Organization (NAFO) Subareas 4, 5 and 6 (Stobo, 1982). Since then, two other large-scale tagging projects have been undertaken. The Pelagics Research Council/Herring Science Council, in collaboration with Fisheries and Oceans, Canada, conducted a tagging project from August 1998 to January 2002. In the fall of 2002, the Fundy Weir Fishermen Association, in partnership with the New Brunswick Department of Agriculture, Fisheries and Aquaculture, Connors Brothers Ltd., the Grand Manan Fishermen's Association and Fisheries and Oceans, Canada, initiated a second herring tagging study focusing on weir fish. Information from both projects has been compiled into one database and the results from all tagging events are described below.

2. PRC/HSC TAGGING PROJECT (1998 - 2001)

2.1 Introduction

In 1998/99, the Pelagics Research Council (PRC), in partnership with the Science Branch of Fisheries and Oceans, Canada (DFO), initiated an extensive herring tagging program. The purpose of this project was to re-evaluate issues relating to herring stock structure and to study herring migration patterns (Paul, 1999; Waters *et al*, 2000). This project continued under the auspices of the Herring Science Council (HSC) and DFO until January, 2002. The focus of this study was the tagging of herring on major spawning grounds and in overwintering areas, but some preliminary experiments were also conducted on herring from New Brunswick weirs. Although this tagging program has now concluded, tags are still being returned. A brief summary of the return information is presented below.

2.2 Results

Over 92,000 tags were applied between August 1998 and January 2002. Table 1 lists the tagging locations and the number of tags applied each year.

Tag Area	Tag Location	Number Tagged					Total Tagged
		1998	1999	2000	2001	2002	
Overwintering Grounds	Chebucto Head		10,250	11,775	11,018	9,605	42,648
	Chedabucto Bay		3,504				3,504
Spawning Grounds	German Bank	9,000	814		9,697		19,511
	Scots Bay	2,399	2,509				4,908
	Trinity Ledge	4,664					4,664
	Eastern Shore		1,941				1,941
Weir Fishery	NB Weirs		10,546	3,536			14,082
Other Tagging	USA		1,389				1,389
TOTAL		16,063	30,953	15,311	20,715	9,605	92,647

Table 1. Herring tag release summary, 1998 to 2002, excluding the 2002/2003 weir tagging data.

Based on information collected from past and present experiments, tag return rates were not expected to exceed 1-2% (Waters *et al*, 2000). For this reason, a return of 988 tags from the 92,647 applied since August 1998 is not surprising.

2.2.1 Overwintering Grounds

A total of 46,152 tags were applied on the overwintering grounds of Chebucto Head and Chedabucto Bay. Table 2 and Figure 1 show the number and location of tag returns from these tagging events. The percentage of tag returns from fish tagged on the overwintering grounds was at the lower end of the expected range (1%).

Table 2. Tag return summary (as of March 2003) from overwintering site applications (January 1999 to January 2002).

Application Location (Releases)	Return Area	Return Location	No. Tags Returned	Total Returns
Chebucto Head (42,648)	Eastern N.S.	Chebucto Head	166	168
		Chedabucto Bay	1	
		Cape Smokey Shore	1	
	Offshore N.S.	Browns Bank	1	15
		Emerald Basin	1	
		Little Patch	2	
		Patch	4	
		Roseway Bank	6	
		Western Hole	1	
	Southwest N.S./ Eastern Bay of Fundy	German Bank	31	152
		Long Island Shore	46	
		Lower East Pubnico	1	
		Northwest Ledge	9	
		NS Weir	23	
		Pollock Lumps/Tow	2	
		Scots Bay	16	
		South of Brier Island	1	
		St. Mary's Bay	10	
		Tongue Ground	6	
		Tusket Islands	1	
		Wedgeport	6	
	Southwest N.B./ Western Bay of Fundy	Bay of Fundy	2	30
		Grand Manan	5	
		NB Weir	11	
		Northeast Bank	4	
		Saint John	1	
		Southwest Bank	3	
		Wolves	4	
	Coastal U.S.A.	Block Island Sound, Rhode Island	1	2
		Long Island, New York	1	
	Unknown	Unknown	59	59
	Total			**426**
Chedabucto Bay (3,504)	Eastern N.S.	Chebucto Head	5	18
		Chedabucto Bay	13	
	Southwest N.S./ Eastern Bay of Fundy	German Bank	1	2
		Lower East Pubnico	1	
	Southwest N.B./ Western Bay of Fundy	Southwest Bank	1	2
		NB Weir	1	
	Unknown	Unknown	4	4
	Total			**26**

Excluding the tags with unknown return locations, the majority of tags applied at Chebucto Head were recaptured near the site of application. Tags were also recovered along the southwest coast of Nova Scotia, on the offshore Scotian Shelf Banks and

southwest New Brunswick. In addition, two tags that were applied to fish off Chebucto Head in January 2001 and 2002 were recovered one year later from Block Island Sound, U.S.A. and Long Island, New York, U.S.A., respectively (Table 1, Figure 1).

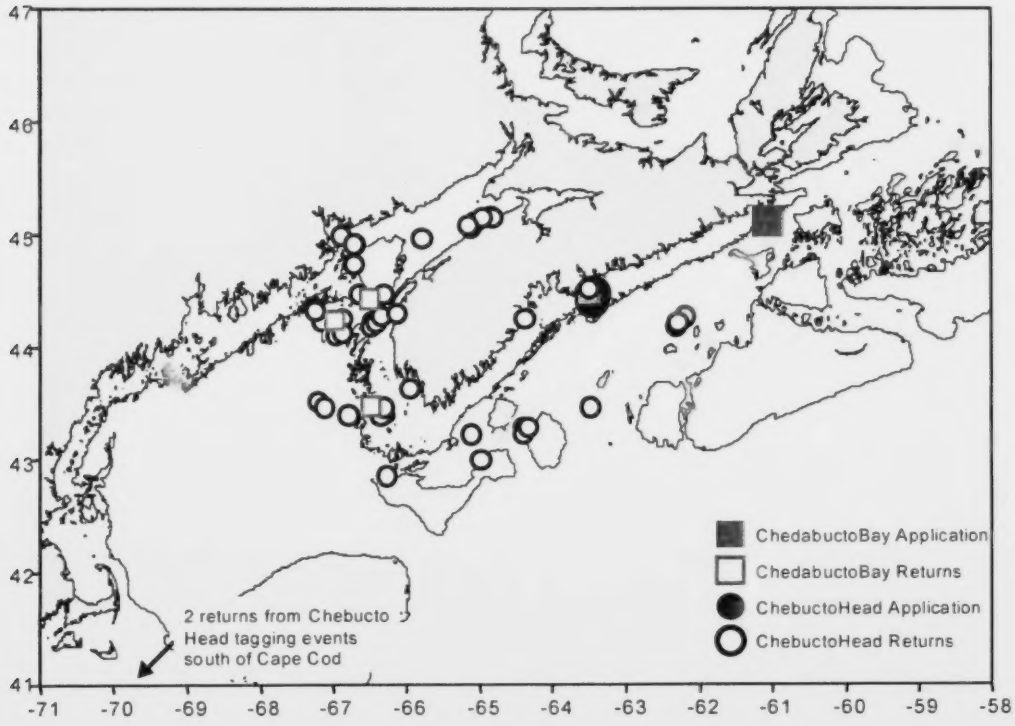

Figure 1. Tag returns (as of March, 2003) from herring that were tagged on overwintering grounds from 1999 to 2002. Closed circles and squares show locations of tag application, open circles and squares show tag return locations.

2.2.2 Spawning Grounds

A total of 21,327 tags were applied on four separate spawning grounds (German Bank, Scots Bay, Trinity Ledge and Eastern Passage) in 1998 and 1999. In 2001, an additional 9,697 tags were applied to spawning herring on German Bank. Table 3 and Figure 2 show the number of tags returned and the location of recovery. The percentages of tag returns from fish tagged on the spawning grounds were low, ranging from 0.6% from German Bank to 0.1% from Trinity Ledge.

Table 3. Tag return summary (as of March, 2003) from spawning site applications (1998 to 2001).

Application Location (Releases)	Return Area	Return Location	No. Tags Returned	Total Returns
German Bank (19,511)	Eastern N.S.	Chebucto Head	1	1
	Offshore N.S.	Browns Bank	1	3
		Little Patch	1	
		Tear Drop	1	
	Southwest N.S./ Eastern Bay of Fundy	German Bank	93	95
		Long Island Shore	1	
		St. Mary's Bay	1	
	Bay of Fundy	Bay of Fundy	1	1
	U.S.A.	Gulf of Maine	1	3
		Stellwagon Bank	2	
	Unknown	Unknown	7	7
	Total			**110**
Scots Bay (4,908)	Offshore N.S.	Browns Bank	1	1
	Southwest N.S./ Eastern Bay of Fundy	Long Island Shore	6	28
		Scots Bay	22	
	Southwest N.B./ Western Bay of Fundy	N.B. Weir	2	2
	Unknown	Unknown	4	4
	Total			**35**
Trinity Ledge (4,664)	Southwest N.S./ Eastern Bay of Fundy	German Bank	2	3
		Long Island Shore	1	
	U.S.A.	Platts Bank, U.S.A.	1	1
	Unknown	Unknown	2	2
	Total			**6**
Eastern Shore (1,941)	Eastern N.S.	Ducks Head	1	3
		Off Shelbourne	1	
		Petpeswick Shoal	1	
	Total			**3**

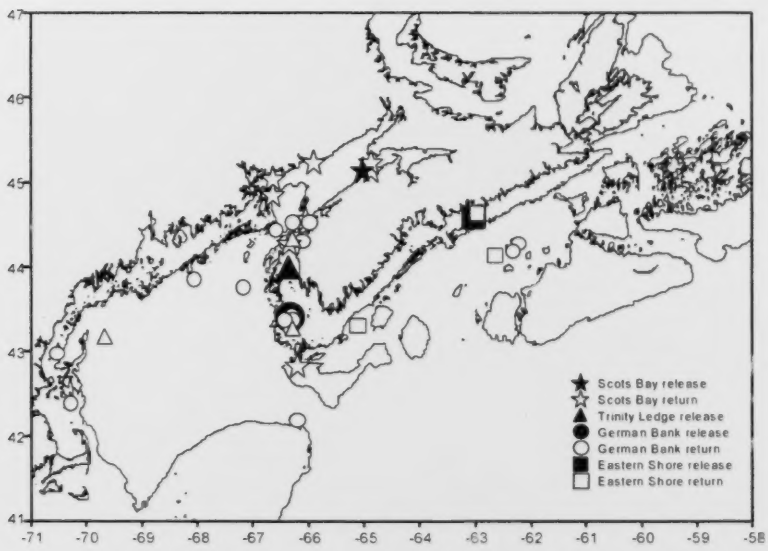

Figure 2. Tag returns (as of March, 2003) from herring that were tagged on spawning grounds from 1998 to Closed stars, triangles, circles and squares show locations of tag application. Open stars, triangles, circles and squares show tag return locations.

2.2.3 New Brunswick Weirs

A total of 14,082 tags were applied to herring from New Brunswick weirs in 1999 and 2000. The return rate from these tagging events was 2%, the upper end of the expected range. This was the best return rate in the project. A high number of returns were from unknown locations or from close to the site of application, but additional recoveries were made from the Nova Scotia side of the Bay of Fundy, Browns and Georges Banks, Chebucto Head and U.S. waters. Table 4 and Figure 3 provide a summary of the tag return information.

Table 4. Tag return summary (as of March, 2003) from herring tagged in New Brunswick weirs (1999 to 2000).

Application Location (Releases)	Return Area	Return Location	No. Tags Returned
New Brunswick Weir (14,082)	Eastern Nova Scotia	Browns Bank	2
		Chebucto Head	2
	Georges Bank	Georges Bank	1
	Southwest Nova Scotia/ Eastern Bay of Fundy	Long Island Shore	12
		Nova Scotia Weir	1
		South of Brier Island	1
	Southwest New Brunswick/ Western Bay of Fundy	Bliss Islands	10
		Campobello	4
		Deer Island	3
		Grand Manan	37
		Indian Island	3
		New Brunswick Weir	64
		Northeast Bank	2
		Prong	3
		Wolves	35
	USA	Haddock Nubble	1
		Schoodic Ridge (off Maine)	3
	Unknown	Unknown	96
	Total		**280**

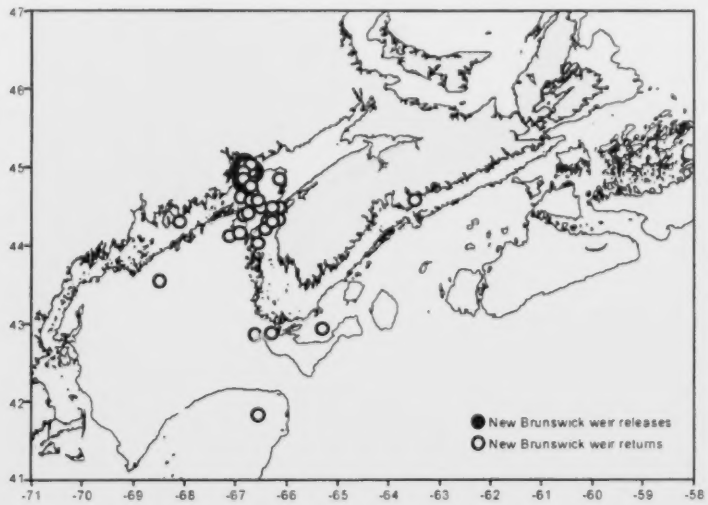

Figure 3. Tag returns (as of March, 2003) from herring tagged from New Brunswick weirs in 1999 and 2000. Closed circles show the locations of tag applications and open circles show tag return locations.

2.2.4 U.S.A.

Table 5 shows the number and location of tag returns from the U.S.A. tagging trip in 1999. Only six tags were returned, a recovery rate of 0.4%.

Table 5. Tag return summary (as of March, 2003) from herring tagged in U.S.A waters (1999).

Application Location (Releases)	Return Area	Return Location	No. Tags Returned	Total Returns
U.S.A. (1,389)	Southwest N.B./ Western Bay of Fundy	Northeast Bank	1	1
	Coastal U.S.A.	Highlands	1	3
		Stellwagen Bank	2	
	Unknown	Unknown	2	2
	Total			**6**

3. WEIR TAGGING PROJECT (2002)

3.1 Introduction

The weir fishery plays a significant role in the livelihood of many individuals throughout Southwest New Brunswick. Weir landings are composed primarily of juvenile herring (ages 1 to 3) that aggregate near the Bay of Fundy shores for summer feeding. In the mid 1970's and early 1980's a number of tagging projects were undertaken to examine the migration patterns of these herring. Information from these experiments led to the hypothesis that many fish from the Bay of Fundy migrate to overwintering grounds along the U.S. coast and northeast to Chedabucto Bay (Stobo, 1982).

Recent changes in fishing activity, including the resurgence of a fishery on Georges Bank, the decline in the number of active weirs in the Bay of Fundy and the increase in the number of aquaculture sites, have prompted scientists and industry to re-evaluate issues relating to the Bay of Fundy herring stocks. For this reason, the Fundy Weir Fishermen Association Inc., in partnership with the New Brunswick Department of Agriculture, Fisheries and Aquaculture, Grand Manan Fishermen's Association, Connors Bros. Ltd., and Fisheries and Oceans, Canada began an extensive tagging study of weir herring in late August, 2002.

Preliminary tagging experiments conducted in 1999 and 2000 in the Bay of Fundy demonstrated that the weir fishery provides a simple and effective venue for tagging fish. Based on the success of these experiments, an application was made to the New Brunswick Department of Agriculture, Fisheries and Aquaculture for funding for a 3 year tagging project focusing on herring from the weirs. Funding was received in the fall of 2002 and from August to November 2002, 13,760 tags were applied to herring from various weirs in the Quoddy Region of the Bay of Fundy. It is proposed that another 140,000 herring will be tagged in the next 2 years.

Few returns are expected from adult fisheries in the initial years of this project since the majority of tagged herring will be juveniles (ages 1 to 3). Herring are not fully recruited to the adult fisheries until age 4.

3.2 Materials and Methods

Funding for this project was received and a project coordinator was hired in September, 2002. Since it was late in the weir fishing season weirs had to be chosen based on the availability of herring. The deck of herring carrier vessels were used as a platform from which to tag since they provided adequate space for tanks, equipment and personnel. After the weir was seined, herring were transferred by dip net into a Xactics tank with a continuous supply of fresh seawater. Herring were immediately tagged using yellow external Hallprint t-bar tags bearing a dual Canada/U.S.A. address as follows:

DFO/SABS NB E5B 2L9
DMR PO 8 W BOOTHBAY Hbr ME 04575

Fish that were less than 10 cm or that appeared unhealthy were not tagged. After inserting the tag between the fin rays at the base of the dorsal fin, herring were placed into a second holding tank until the regular seining of the weir was completed. Herring were released back into the water after the carrier vessel moved away from any surrounding weirs. This helped reduce the likelihood that the herring would return immediately to a weir.

A random sample of 100 to 200 herring was collected during each trip for the purpose of taking length frequency measurements. For every new area visited, a sub-sample was frozen for detailed laboratory analysis of age, sex and maturity.

Throughout the project tag returns have been collected and the information entered into a database. For every tag received, the name of the recipient has gone into an annual $1000 draw. A protocol already exists in many processing plants to encourage individuals to return tags. Posters and newspaper articles are being used to advertise this tagging program.

3.3 Results and Discussion

Despite the late start of the project, poor weather and other constraints, a total of 21 successful tagging events were conducted at 12 different weirs throughout the Quoddy Region. One tagging trip was also made off Grand Manan on the seiner, The Margaret Elizabeth II. Table 6 gives a list of the various tagging locations and the number of tags that were applied during each trip. The majority of tags were applied from weirs off Campobello and Bliss Island. Other locations included Deer Island, the Wolves and Grand Manan (Table 6, Figure 4). Overall, a total of 13,760 herring were tagged between August 21, 2002 and November 4, 2002.

Table 6. Herring tag applications in the Quoddy Region, August to November, 2002.

Date	Weir/Location	Total Tagged	Running Total
21-Aug-02	Eagle Island	640	640
17-Sep-02	Bulls Eddy	229	869
18-Sep-02	Rattle Rock	785	1,654
18-Sep-02	Pup	403	2,057
18-Sep-02	Spruce Isl (Carney Cove)	524	2,581
19-Sep-02	James (Fry)	363	2,944
19-Sep-02	Eagle Island	841	3,785
23-Sep-02	Marnier (Beach)	1,006	4,791
24-Sep-02	Pup	998	5,789
25-Sep-02	Eagle Island	997	6,786
26-Sep-02	Back	491	7,277
26-Sep-02	Pup	608	7,885
30-Sep-02	Rattle Rock	344	8,229
30-Sep-02	Spruce Isl (Carney Cove)	469	8,698
04-Oct-02	Eagle Island	600	9,298
04-Oct-02	Abnaki	392	9,690
08-Oct-02	Marnier (Beach)	500	10,190
09-Oct-02	Eagle Island	675	10,865
10-Oct-02	Batchler	775	11,640
20-Oct-02	Dreadnaught (Black Water)	549	12,189
22-Oct-02	Casco	550	12,739
04-Nov-02	Grand Manan	1,021	13,760

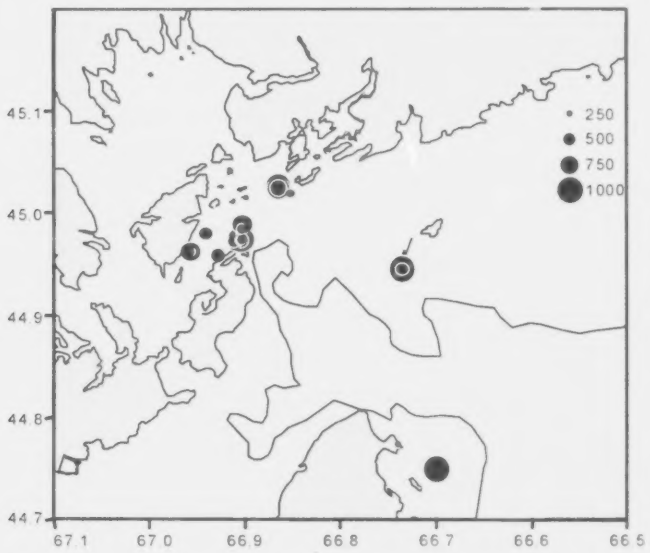

Figure 4. Weir tagging in the Quoddy Region, Aug. to Nov., 2002. The size of the markers indicates the number of herring that were tagged.

Herring that are considered part of the Bay of Fundy juvenile fisheries are, for the most part, under 23cm in length (Stobo *et al.* 1975). The majority of fish that were measured from tagging trips were between 14.5 cm and 16.0 cm with the average length

of all fish sampled being 16.6 cm (Table 7, Figure 5). Individual length frequencies for each tagging event are shown in Appendix A. The smallest fish measured was 10.5 cm and the largest was 29.0 cm. It was not unexpected to see some larger fish since the mouth of the Bay of Fundy has been shown to harbour pre-spawning adults during the summer months (Stobo, 1982).

Table 7. Average length of herring tagged in the Quoddy Region (Aug. to Nov., 2002).

Date	Weir/Location	Length (cm)	Average Length (cm)
21-Aug-02	Eagle Island	13.0 - 29.0	21
17-Sep-02	Bulls Eddy	13.5 - 21.5	18.6
18-Sep-02	Rattle Rock	11.5 - 25.5	16.2
18-Sep-02	Pup	12.0 - 21.0	16.8
18-Sep-02	Spruce Island	15.0 - 24.5	19.1
19-Sep-02	James	13.0 - 27.0	16.4
19-Sep-02	Eagle Island	No Sample	0
23-Sep-02	Marnier	13.0 - 22.0	15.6
24-Sep-02	Pup	13.5 - 20.5	16.1
25-Sep-02	Eagle Island	12.0 - 26.0	14.6
26-Sep-02	Back	13.0 - 26.5	16.7
26-Sep-02	Pup	13.5 - 25.5	16.6
30-Sep-02	Rattle Rock	12.5 - 21.5	15.6
30-Sep-02	Spruce Island	13.0 - 21.0	17.3
04-Oct-02	Eagle Island	13.0 - 24.5	14.9
04-Oct-02	Abnaki	13.5 - 21.0	16.5
08-Oct-02	Marnier	13.5 - 18.5	15.4
09-Oct-02	Eagle Island	13.0 - 22.5	14.9
10-Oct-02	Batchler	13.0 - 22.0	17
20-Oct-02	Dreadnaught	12.5 - 19.5	15.4
22-Oct-02	Casco	13.0 - 23.5	15.6
04-Nov-02	Grand Manan (Set 1)	12.0 - 24.5	18.4
04-Nov-02	Grand Manan (Set 2)	10.5 - 27.0	16.2
Average			**16.6**

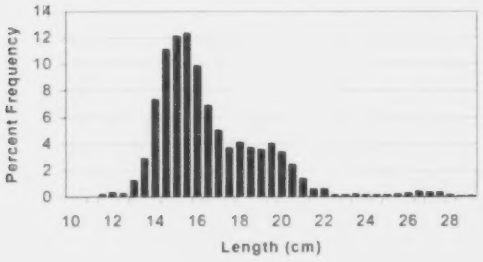

Figure 5. Average length frequency of 22 samples collected Aug. 21 to Nov. 4, 2002.

The maturity stage and sex of herring collected for detailed samples was assessed in the lab at the St. Andrews Biological Station using the ICES protocol (Parrish *et al*, 1965)

(Table 8). As expected, the majority of fish in the detailed samples were juveniles (stages 1 and 2) (Table 9, Figure 6). Maturity frequencies are in Appendix B.

Table 8. Maturity staging for fresh herring as applied by the St. Andrews Biological Station herring investigation (ICES, 1965).

Stage	Males	Females
1	Virgin herring. Testes very small, threadlike, whitish or grey-brown	Virgin herring. Ovaries very small 1-3mm broad, wine-red or pinkish color
2	Virgin herring with small sexual organs. Width of testes about 3-8 mm. Wedge shaped with a knife edge in cross section and reddish grey in color	Virgin herring with small sexual organs. Width of ovaries about 3-8mm, eggs not visible to naked eye but can be seen with magnifying glass, oval in cross-section, wine-red or pinkish
3	Testes about half the length of body cavity. Width of testes between 1-2 cm, reddish grey or greyish color, double lobe at distal end	Ovaries about half the length of body cavity. Width between 1-2 cm, distal end is torpedo shaped, eggs small but can be distinguished with naked eye, overall color is orange
4	Testes almost as long as body cavity and whitish in color	Ovaries almost as long as body cavity. Eggs larger, varying in size, eggs opaque. Overall color is orange or pale yellow
5	Testes fill body cavity, testes milk white. Sperm does not flow but can be sometimes be extruded by firm pressure	Ovaries fill body cavity. Yellowish in color. Eggs large, round, some transparent but do not flow with pressure
6	Testes ripe, white color and sperm flows freely	Ovaries ripe. Eggs transparent and flowing freely
7	Spent herring. Testes baggy and bloodshot but may contain remains of whitish sperm	Spent herring. Ovaries baggy and bloodshot, empty or containing only a few residual eggs
8	Recovering spent. Testes firm and larger than virgin herring at stage 2. Walls of testes striated, blood vessels prominent, testes dark wine-red in color. (This stage passes into Stage 3)	Recovering spent. Ovaries firm and larger than virgin herring at stage 2. Eggs not visible to naked eye. Walls of ovary striated, blood vessels prominent, dark wine-red in color. (This stage passes into Stage 3)
0	Unable to determine stage	Unable to determine stage

Table 9. Number and average % maturity of weir herring tagged in the Quoddy Region from Aug - Nov, 2002.

Maturity Stage	Total Number		Average %	
	Males	Females	Males	Females
1	110	59	47.8	26.31
2	15	24	8.23	11.95
3	0	0	0	0
4	0	1	0	0.27
5	7	6	1.9	1.63
6	2	2	0.54	0.54
7	0	1	0	0.27
8	1	1	0.27	0.27
Total:	**135**	**94**	**58.74**	**41.24**

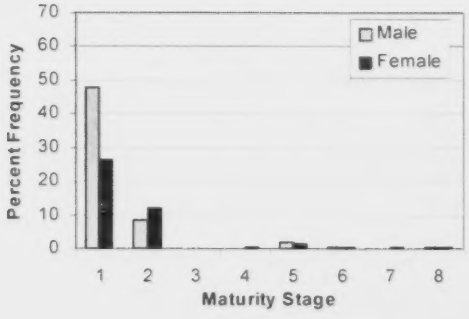

Figure 6. Percent frequency of maturity stages by sex for 8 samples collected from Aug. 21 to Nov. 4, 2002.

Tag recovery affects the outcome of any tagging project. Since 1999, a total of 376 tags have been recovered with the majority of them being from the Bay of Fundy area (Table 10). Including the tag that was recovered off Browns Bank following a tagging trip off Indian Island in 2000 (Figure 7), and the tag returns for which the application site is unknown, 93 tags were recovered in 2002/2003. From the 93 tag returns, 80 were from the Bay of Fundy. With the exception of 10 tags, all of the return information (date, location) for 2002 and 2003 is known. The increase in tag return information in recent years is likely due to improvements in advertising methods that inform fishers and plant workers about the project and make them more aware of its importance.

Table 10. Recovery numbers and locations for weir herring tagged from 1999 to 2002.

Return Area	Return Location	1999	2000	2001	2002	2003	Unknown	Recoveries
Western Bay of Fundy/ Southwest New Brunswick	Bliss Island	9	1					10
	Campobello	3		1	2			6
	Deer Island				3			3
	Grand Manan	23	4	10	8	8		53
	Indian Island	3					1	4
	N.B. Weir	51	6	7	18		1	83
	Northeast Bank		2					2
	Wolves Island	33	2		4	36		75
Eastern Nova Scotia	Chebucto Head			2				2
Southwest Nova Scotia/ Eastern Bay of Fundy	Long Island Shore	11		3				14
	Northwest Ledge				1			1
	Prong			3				3
	Scots Bay				1			1
Offshore Nova Scotia	Browns Bank		1		1			2
Coastal U.S.A.	Haddock Nubble			1				1
	Ipswich Bay				1			1
	Schoodic Ridge	3						3
Georges Bank				1				1
Unknown		56	39	1	6	4	5	111
Total		192	55	29	45	48	7	**376**
Total Tags Applied		10,546	3,536	0	13,736	0		**27,818**

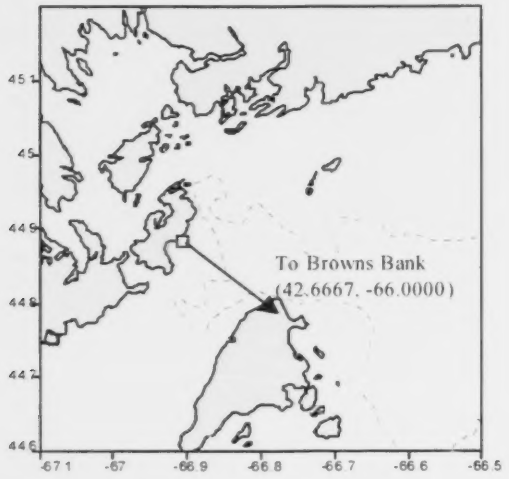

Figure 7. Herring tag returned in 2002. The fish was tagged during an Indian Island tagging trip in September 2002.

Since the commencement of this project in August 2002, a total of 92 tags, out of 13,736 applied, have been returned (Table 11). The majority of returns have been close to the area of application (Figure 8). Tags have been returned from the fall weir fishery and the winter purse seine fishery near Grand Manan and the Wolves (Table 11).

Table 11. 2002/2003 herring tag recoveries (to March, 2003).

Weir/Location	Date(s) Tagged	# Fish Tagged	Recoveries		Total
			2002	2003	Returns
Eagle Island	Aug 21, Sep 19, 25	3,753	24	16	40
	Oct 4 & 9, 2002				0
Pup	Sep 18, 24, 26, 2002	2,009	7	7	14
Spruce Island	Sep 18 & 30, 2002	993	4	5	9
Rattle Rock	Sep 18 & 30, 2002	1,129	3	1	4
James	Sep 19 2002	363	1	2	3
Marnier	Sep 23, Oct 8	1,506	3	3	6
Back	Sep 26 2002	491	1	1	2
Abnaki	Oct 4 2002	392	1	6	7
Bulls Eddy	Sep 17 2002	229	0	0	0
Batchler	Oct 10 2002	775	0	2	2
Dreadnaught	Oct 20 2002	549	0	0	0
Casco	Oct 22 2002	550	0	1	1
Grand Manan	Nov 4 2002	1,021	0	4	4
Total:		**13,760**	**44**	**48**	**92**

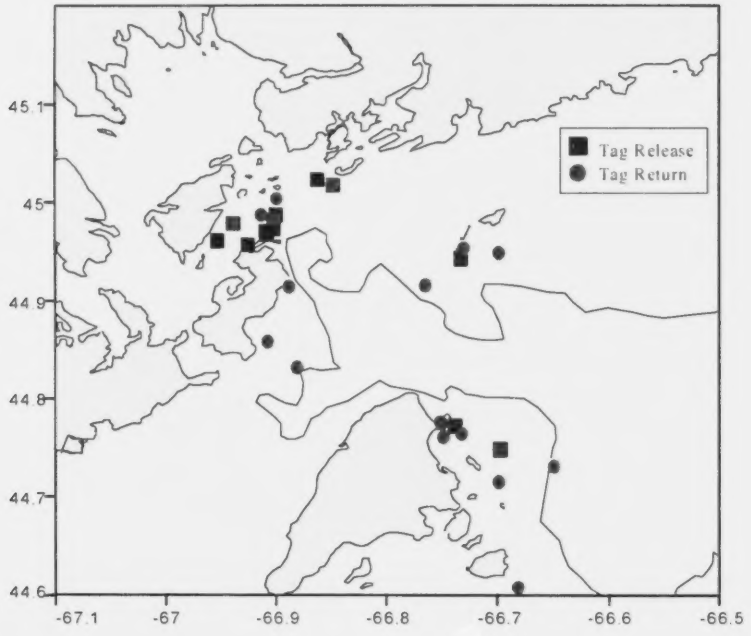

Figure 8. Herring tag releases and returns for the Quoddy Region, May 2002 to March 2003.

It is currently too early in the experiment to determine fine scale movement patterns from the data. With further tagging in 2003 and 2004 more information will be gathered on in-season movements within the Bay of Fundy.

On August 21, 2002 fish were tagged from the Eagle Island weir. Connors Brothers, Ltd. had alerted staff at the St. Andrews Biological Station that there were large fish in this weir. A total of 640 fish were tagged and length frequency and detailed samples were taken (Figures 9, 10 and 11). Unlike samples taken from weirs later in the season (Figure 5), the length frequency of fish from this tagging event was bimodal, with a second mode at around 26.5 cm (Figure 9). When the maturity of these fish was examined, a peak of pre-spawners (stage 5) was observed, along with the expected juvenile fish (Figure 10). In addition fish from the sample collected on the August 21 trip (Figure 11) had a higher percentage of 3, 4 and 5 year olds than those collected from the same weir in September and October (Figure 12).

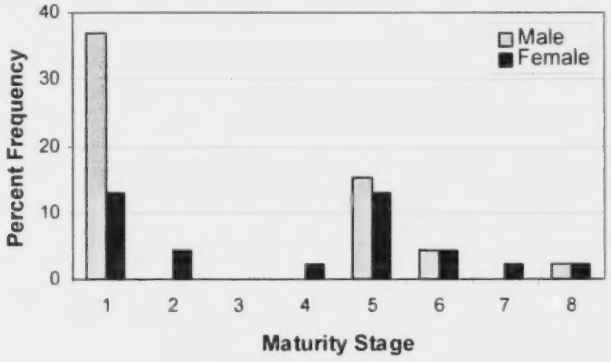

Figure 9. Length Frequency of herring sample from Eagle Island Weir, August 21, 2002.

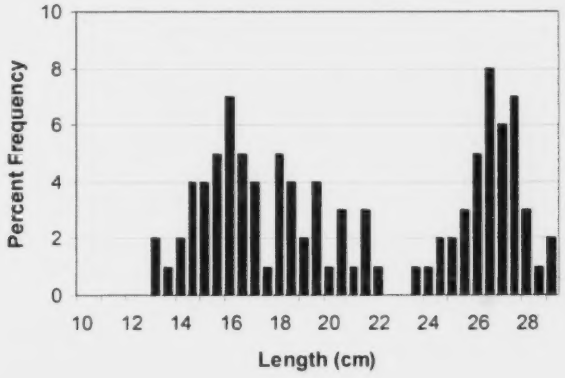

Figure 10. Maturity stages of herring in the sample taken from Eagle Island Weir, August 21, 2002.

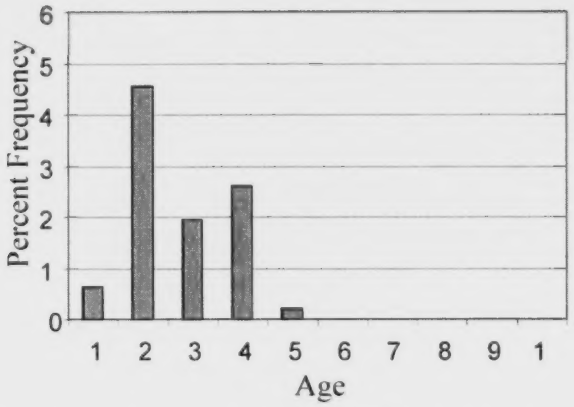

Figure 11. Ages of herring in the sample taken from Eagle Island weir, September and October, 2002.

Figure 12. Ages of herring from samples taken from the Eagle Island weir, September and October, 2002

As with other tagging events, the majority of tag returns from those applied at Eagle Island on August 21 were from close to the area of application (Figure 13). Three tags, however, were from farther afield. The first was from an aggregation of spawning fish in Scots Bay six days after tagging, the second from Northwest Ledge on September 11th and the third from the overwintering grounds in Ipswich Bay on November 24th, 2002 (Figure 13). It is not known if the long distance returns were from large herring. In future, large and small herring will be tagged and sampled separately to determine if there are differences in their movement.

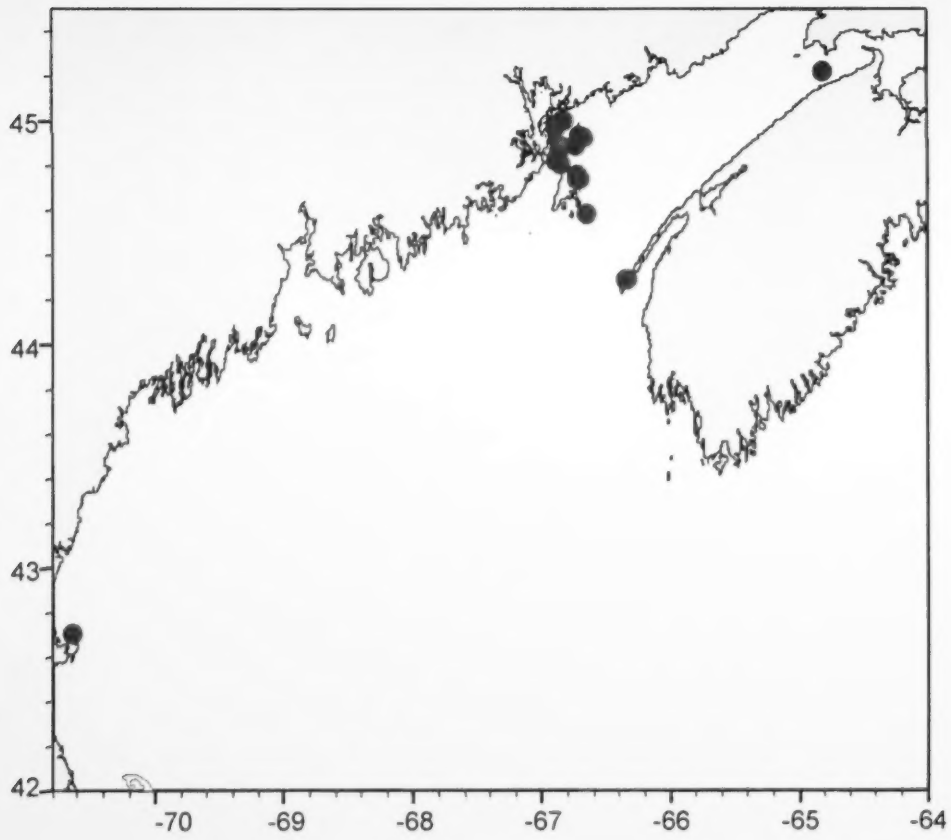

Figure 13. Tag returns from fish tagged at Eagle Island Weir, August 21, 2002.

3.4 Recommendations

Tagging Schedule

Time placed a huge constraint on the 2002 tagging program. Funding was received near the end of the fishing season and only a small number of weirs were still fishing. As a result, tagging sites were selected depending on the availability of fish. To get a better picture of the movement of herring in the Bay of Fundy tagging should commence as early in the season as possible. In previous years, weirs have been seined as early as mid-May.

According to the historical catch data from 1999 - 2002 herring have been moving into weirs around Bliss Island, Deer Island and Campobello Island in May and then toward Grand Manan in June. Finally they have been entering the weirs off the Wolves in July (Appendix C). A possible tagging schedule following this pattern of movement is proposed.

Fish Health and Safety

Herring tend to lose scales very easily so handling of the fish must be kept at a minimum. A funnel system, which releases the fish underwater immediately after being tagged, will eliminate the use of a second holding tank thus reducing scale loss. It will also cut down on mortality by gulls since surface exposure will be eliminated.

Advertising

The amount of information received with returned tags has improved over the last few years, however, additional advertising and promoting is required in the next two years. This will include plant visits, press releases, putting up posters and making presentations to fishing industry groups, government personnel and other interested parties.

4. Acknowledgements

The success of the 2002 Bay of Fundy Weir Tagging Project is due to the dedication and cooperation of various industry and government personnel. The authors would like to thank Bob Cochrane of the Fundy Weir Fishermen Association, Inc. for his administrative role and overall supervision of this project; the herring group at the Biological Station in St. Andrew's, New Brunswick for their scientific advice and training; Nicole Seamone for her assistance with tagging; and a variety of others who also assisted in tagging herring. Finally, we would like to acknowledge Tony Hooper, Greg Glennie and the other employees of Connors Bros., and the fishing crews of the various herring carrier vessels with special thanks to Garnet and Brendon Green of the Haven Lady for the extended help they provided.

5. References

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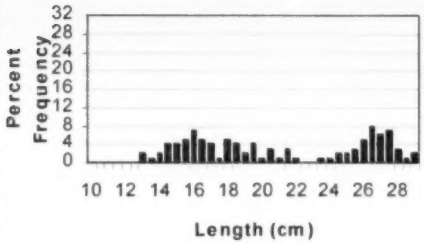
Waters, C.L., R.L. Stephenson, K.J. Clark, F.J. Fife, M.J. Powers and G.D. Melvin. 2000. Report of the PRC/DFO 4VWX herring and mackerel tagging program. DFO Canadian Stock Assessment Secretariat Res. Doc. 2000/67: 29pp.

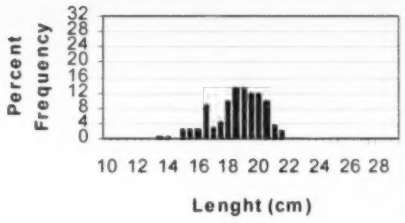
Appendix A

Percent length frequency for samples measured during tagging trip

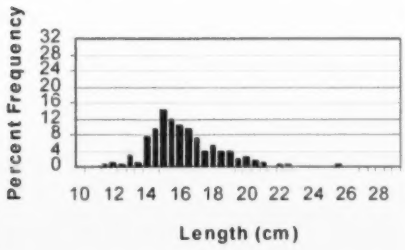
A-1 Eagle Island Weir - Aug 21, 2002



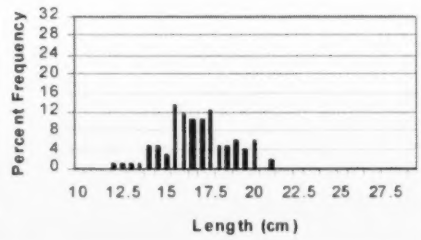
A-2 Bulls Eddy Weir - Sept 17, 2002



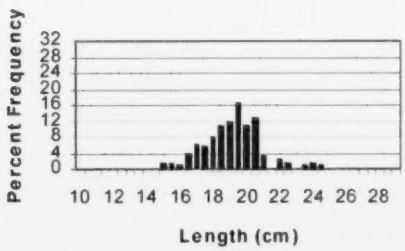
A-3 Rattle Rock Weir - Sept 18, 2002



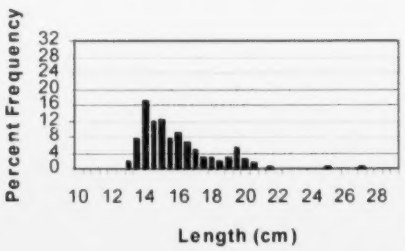
A-4 Pup Weir - Sept 18, 2002



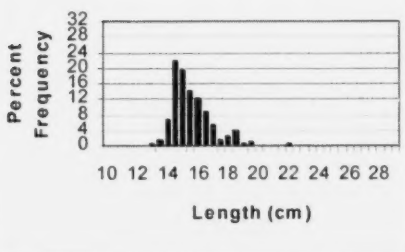
A-5 Spruce Island Weir - Sept 18, 2002



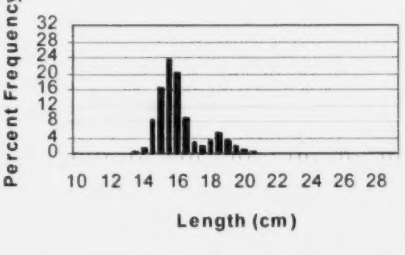
A-6 James Weir - Sept 19, 2002



A-7 Marnier Weir - Sept 23, 2002

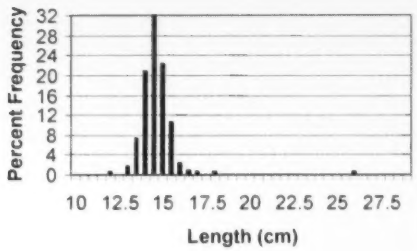


A-8 Pup Weir - Sept 24, 2002

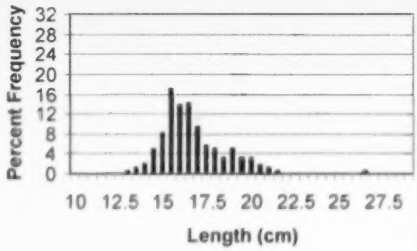


Appendix A continued

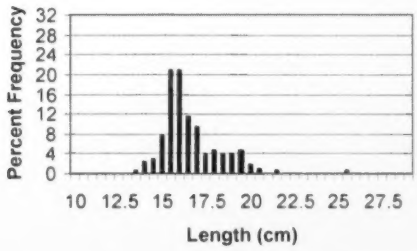
A-9 Eagle Island Weir - Sept 25, 2002



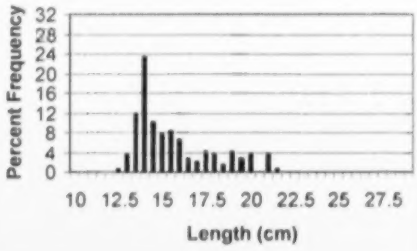
A-10 Back Weir - Sept 26, 2002



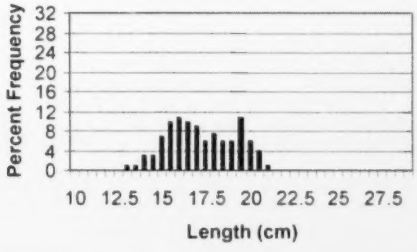
A-11 Pup Weir - Sept 26, 2002



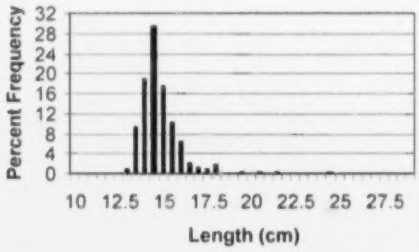
A-12 Rattle Rock Weir - Sept 30, 2002



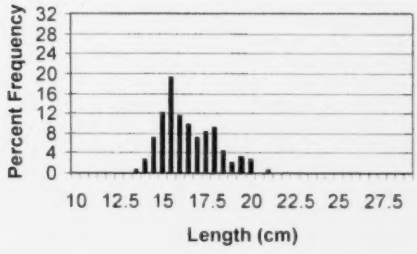
A-13 Spruce Island Weir - Sept 30, 2002



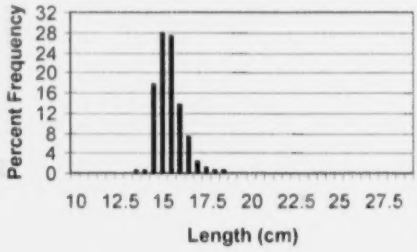
A-14 Eagle Island Weir - Oct 4, 2002



A-15 Abnaki Weir - Oct 4, 2002

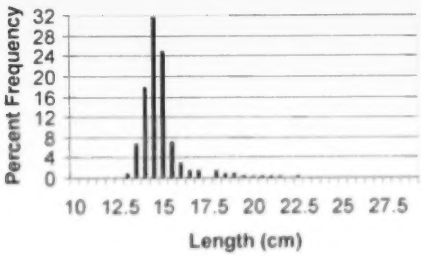


A-16 Marnier Weir - Oct 8, 2002

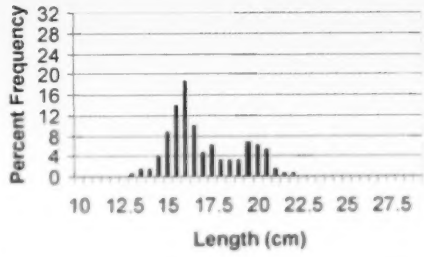


Appendix A continued.

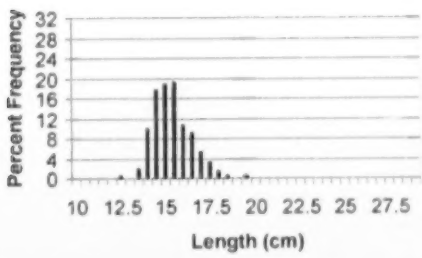
A-17 Eagle Island Weir - Oct 9, 2002



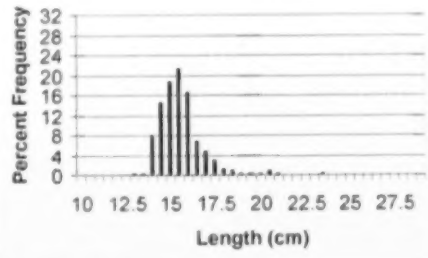
A-18 Batchler Weir - Oct 10, 2002



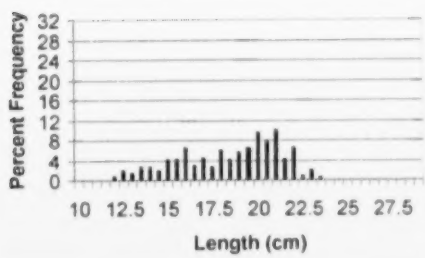
A-19 Dreadnaught Weir - Oct 20, 2002



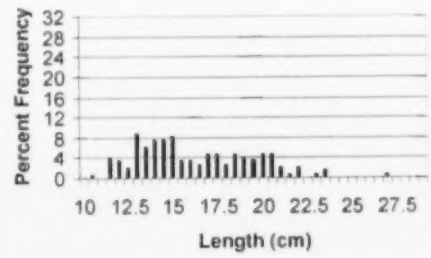
A-20 Casco Weir - Oct 22, 2002



A-21 Grand Manan (Set 1) - Nov 4, 2002

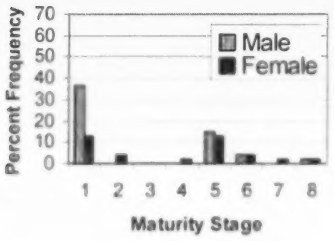


A-22 Grand Manan (Set 2) - Nov 4, 2002

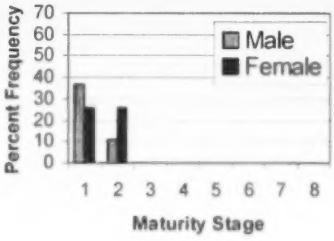


Appendix B: Percent frequency of maturity for frozen samples of weir herring.

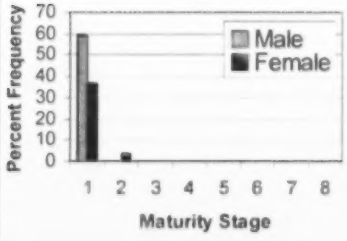
B-1 Eagle Island Weir - Aug 21, 2002



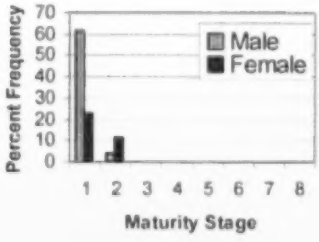
B-2 Bulls Eddy Weir - Sept 17, 2002



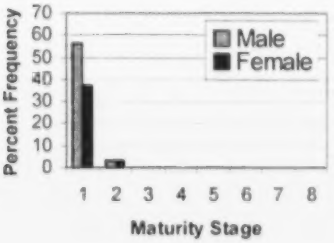
B-3 Marnier Weir - Sept 23, 2002



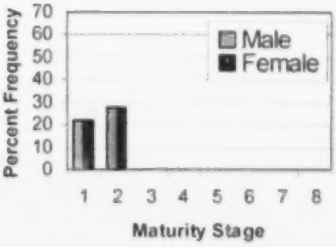
B-4 Spruce Island Weir - Sept 30, 2002



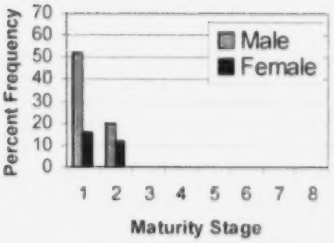
B-5 Eagle Island Weir - Oct 4, 2002



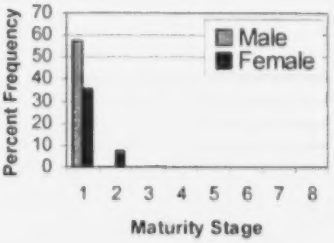
B-6 Marnier Weir - Oct 8, 2002



B-7 Dreadnaught Weir - Oct 20, 2002



B-8 Casco Weir - Oct 22, 2002



Appendix C: 1999 - 2002 New Brunswick Herring Weir Catches.

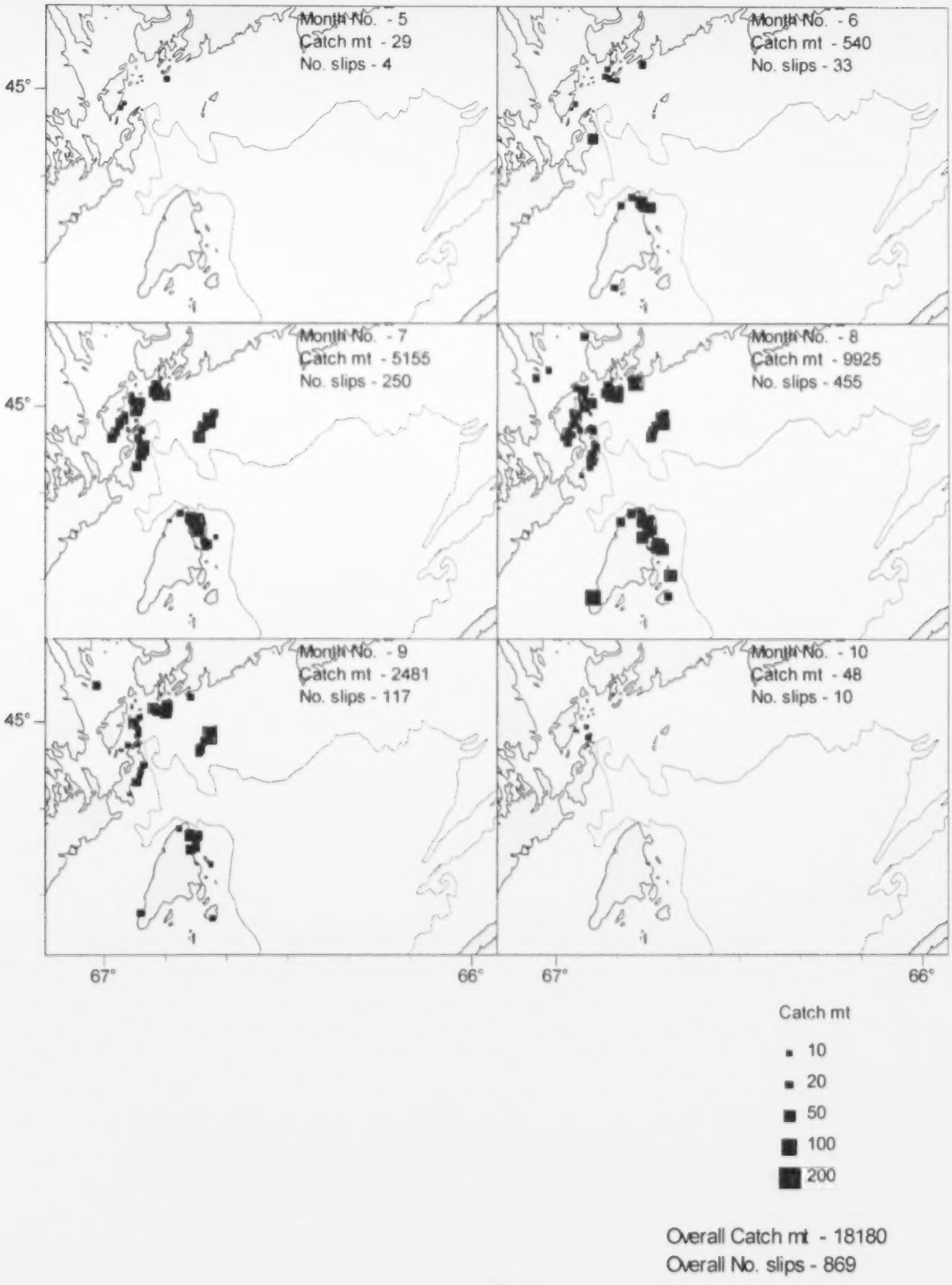


Figure C-1. 1999 New Brunswick herring weir catches by month using exact weir locations.

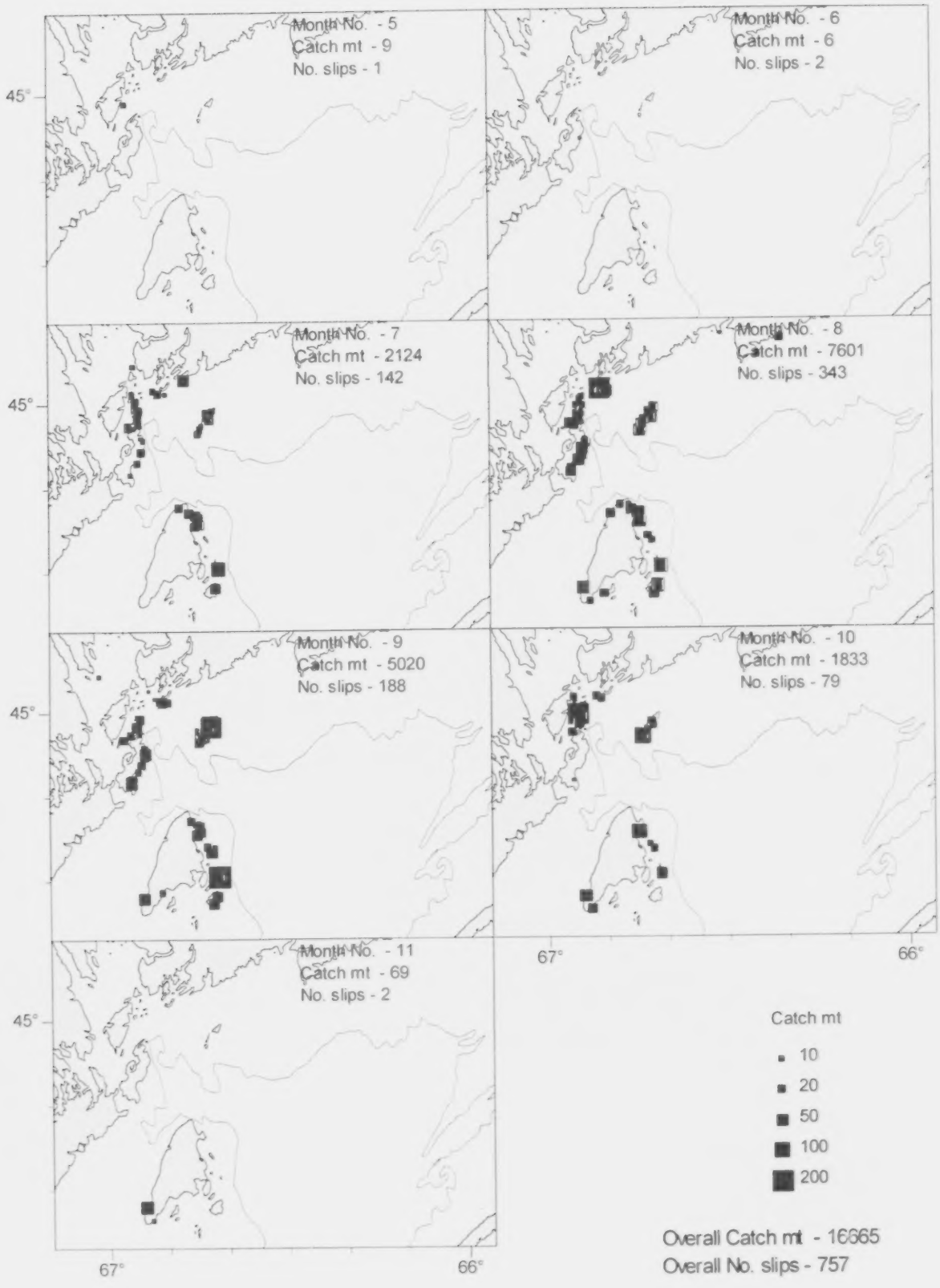


Figure C-2. 2000 New Brunswick herring weir catches by month using exact weir locations.

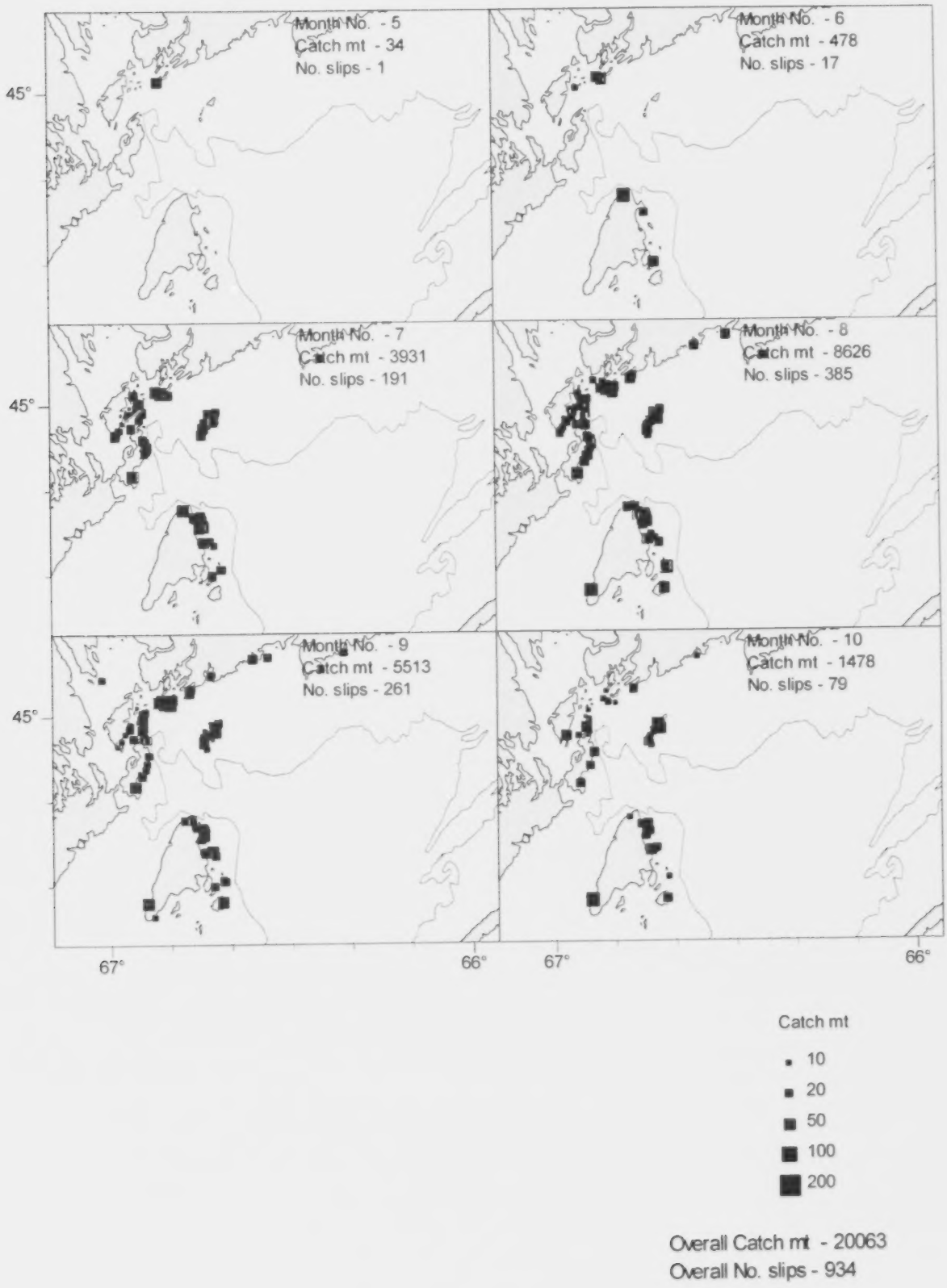


Figure C-3. 2001 New Brunswick herring weir catches by month using exact weir locations.

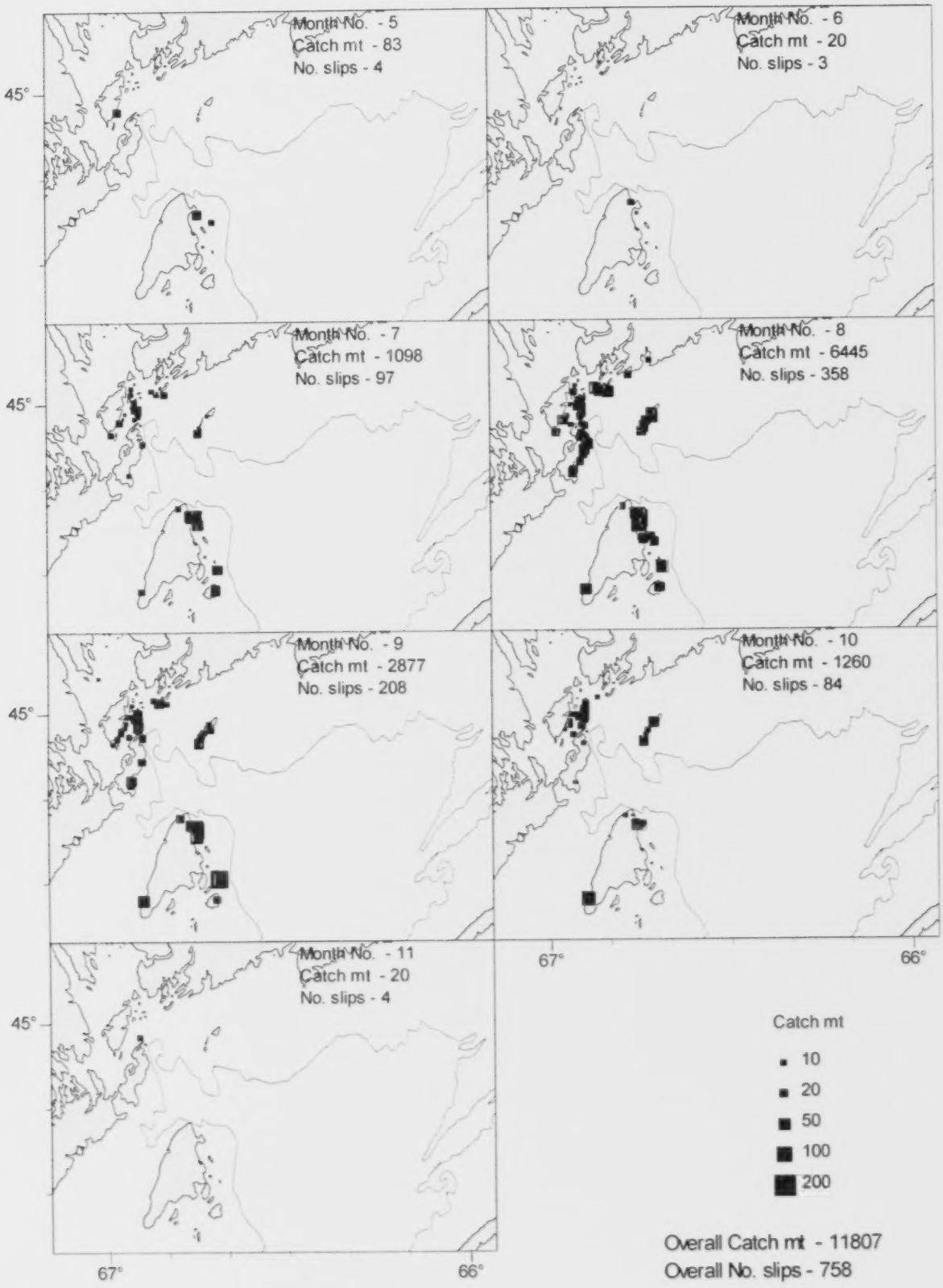


Figure C-4. 2002 New Brunswick herring weir catches by month using exact weir locations.